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Generating Computer Graphics Using DDA Algorithm

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***Abstract*— Computer graphics are the primary and most efficient way to exchange information between humans and computers. They are also now used widely in many different areas such as teaching, education, entertainment, art as well as image processing, user interfaces, etc. Computer graphics are the chief way of visualization of an abstract idea or concept that can be portrayed by a computer. As technology progresses, the overall scope as well as the quality of these graphics and their generation will continue to improve and will get more popular and widely used. This paper focuses on the various computer graphics generation methods and their evolution. This needs to be done to get a better understanding of the topic overall and to get familiar with this increasingly important topic.**

Keywords*— *Computer graphics, visualization, graphical representation, human-computer interaction

I. *INTRODUCTION*

The subject of computer graphics is a loose term but it mainly deals with the generation of images with the help of computers. Today computers are so widely spread and used and a proper graphical user interface has become the status quo, hence computer graphics are widely used and hence need to be studied well. They are now a core technology in any form of image-based or vision-based systems as well as many specialized applications with their graphics as per the need. In the past two or three decades, a lot of specialized hardware as well as software has been developed keeping computer graphics in mind and hence has allowed this sudden development of the field into a vast area. Apart from the computer science-related part of it, it has also very inseparably seeped into artistic expressions as well. It is a vast field with many different areas such as user interface design, rendering, ray tracing, geometry processing, animation, vector graphics, 3-D modeling, shaders, etc.

Computer graphics are the main tools used to display the image data or art meaningfully to the user and are also used to process the data obtained from the real world such as photos or video content by using image processing. The sudden developments in the field have allowed for a revolution in all forms of visual media with advertisements, movies, animations, and video games being the primarily noticeable ones. The term computer graphics usually means one of the several things-

(a)It is the representation and manipulation of the image data by a computer.

(b)The various technologies and tools used to create or manipulate the images.

(c)The methods which are used to digitally produce and control the visual content.

Visual representations are always easier to understand and make sense of than the complex statistics or the data they are trying to convey eg- graphs. They are easy to interpret and hence are a widely used form to convey information. With the help of computer graphics, this can all now be computer generated and hence allows the easily interpretable form to be more widely available and accessible. The precursors to modern-day graphics are the advancements in electrical and electronic engineering and screens could display art ever since the early 20th century. But the discipline of computer graphics as a whole was not fully established till after the second world war. The 1950s made the cathode ray tube viable as a display and introduced the light pen as an input device. In 1968, the first form of ray tracing algorithm was made, which has now become fundamental in achieving photorealism in computer graphics by simulating the path of light rays from the source to the surfaces in a scene.

In the 1970s the transformation of computer graphics from utilitarian ones to realistic ones was started. Along with that, the popularity of home computers was increasing and hence a new demand in the field of computer graphics was being made as well. As a result, the discipline which was strictly academic at first now got a lot of popularity and a much larger audience. In the next two decades, the overall hardware technology will also be improved drastically which will allow the betterment of the topic.

In the 2000s computer-generated images were found everywhere and media like movies and video games further popularised Computer Generated Imagery to the main-stream and have continued to do so even now. Since the 2010's even video generation can be done using computer graphics and photorealism has reached a level that on a high-end system it's difficult to point out the differences between real images and computer-generated images.

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II. *Problem Statement*

Designing catalogues, Creating Commercial Arts, and Scientific Modeling (Ex: Meteorological data, Weather Forecasting). In this project, we are generating computer graphics by using DDA Algorithm. This algorithm can produce various figures and shapes which can further be used for many applications that are useful in the current scenarios. Some of its applications include the development of computer programs, producing films, Video- Games (Ex: Platformers, Role-playing games, sidescrollers, first-person shooter games).

III. LITERATURE REVIEW

[1] McConnell, Jeffrey & Carson, George. In-depth study of all the varied technologies and methodologies employed in the study of computer graphics generation. Lacking in terms of actual generation methods still as modern-day relevance.

[2] W. Jack Bouknight. 1970. A description of an algorithm to come up with a 3-dimensional polygonal surface. The algorithm is far faster than the Warnock algorithm from Utah. This paper helped a lot to understand the scope of computer graphics during that time as well as the evolution of graphics algorithms as time went on. The limitation of the paper is its relevance is totally gone as it is from over 40 years ago.

[3] J. Amanatides, This paper tells us about the trends and development of realism in computer-generated graphics. This paper goes into detail and explains various rendering processes and surface determination algorithms.

[4] Przemyslaw Rokita, This paper proposes a new and replaceable technique to generate depth in computer-generated scenes because it would be visible to human eyes. The algorithm mentioned in this paper is suitable for real-time applications such as visual simulators.

[5] J. Amanatides, This paper tells us about the trends and development of realism in computer-generated graphics. This paper goes into detail and explains various rendering processes and surface determination algorithms.

[6] A. Shamir, M. Rubinstein, and T. Levinboim, This paper is a unique take on computer graphics with a different application. It is regarding a system that can convert important parts of a storyboard and interactions in 3D graphics to a comic book-like 2D art style.

[7] V. Cantoni, P. Dondi, L. Lombardi, and A. Setti, This paper is about the teaching of computer graphics to people and is interesting in branching out a study about the topic. It talks about the key challenges and methods used to teach computer graphics using 3D modelling of a city and makes us think about the topic from a different aspect and point of view.

[8] Julie Dorsey and Leonard McMillan. This paper talks about the long run and the future scope of the topic and the technology that is currently state of the art. It is from 1998 and hence allows us to check retrospectively the condition in which computer graphics was a couple of decades ago as well as the future scope according to then.

[9] H. Wang, W. Chen, X. Liu, and B. Dong, This paper is about terrain modelling using fractals. Virtual realistic terrain modelling can be achieved using this algorithm which is a modification of the classical Diamond-Square algorithm and implemented using OpenGL and Visual C++.

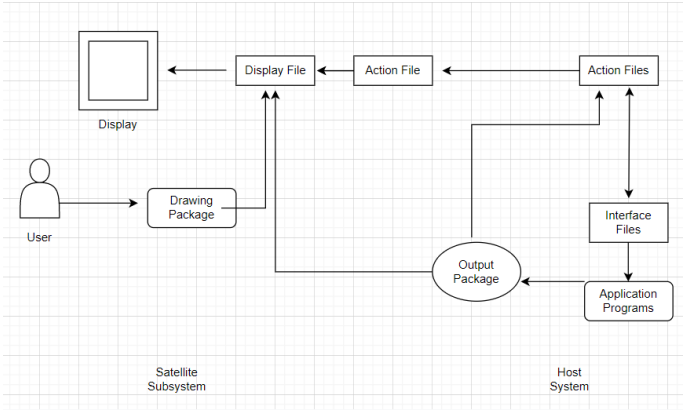
[10] Canlin Li, Chao Yin, Jiajie Lu, and Lizhuang Ma, This paper is about automatic 3D scene generation using Autodesk Maya. This paper tells about the disadvantages of using manual 3D scene generation and it aims to solve them by automating the process. This paper is related to computer graphics and the exact problem statement is about automation.

[11] R. Pickles, This paper surveys and gives information about the Vulkan libraries which are considered to be the next generation of embedded graphics or computer graphics libraries after OpenGL and CUDA.

[12] V. L. Paucar, O. S. de Sousa, I. O. Almeida, M. J. Rider, M. F. Bedrinana and J. H. Santos,
This paper is about software development primarily and isn't based on computer graphics but talks a fair and good amount about it and helps us understand better the application of computer graphics clearly.

[13] M. Oku, This paper proposes a simple algorithm to generate 2D graphics like bubbles, as well is useful for graphs, geographical data visualization, and image warping. It's a modern as well and a simple algorithm but the uses of this algorithm might be limited as it is based on 2 dimensions.

IV. Flowchart



Examples of some Computer Graphics Packages:

1) LOGO(Language of Graphics Oriented)
2) Corel Draw
3) Auto Cad
4) 3D Studio
5) Core
6) GKS(graphics kernel system)
7) Pigs
8) CAM
9) CGI

V. *Methodology/Implementation*

For this project, we decided to use a simple algorithm to implement and generate computer graphics. The algorithm is called a "digital difference analyzer" or DDA for short. It is used for the insertion of variables over an interval between a start and endpoint. This is mainly used to pixelate and convert any given lines/ polygons into raster images. This algorithm can also be further applied to non-linear functions but that is much more advanced and currently beyond the scope of our implementation.

For the most basic cases in linear implementation, the model uses slope to find out whether the pixel between the interval satisfies based on the slope (the simplest case is a line).

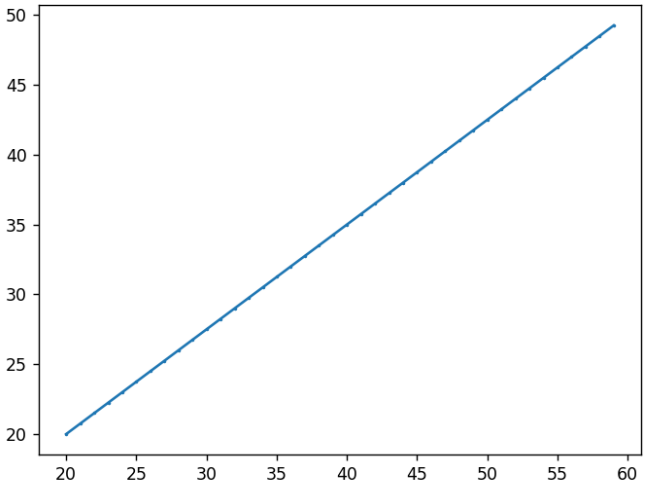
Further is a mathematical representation of the algorithm.

Algorithm:

Step 1: Start the Algorithm
Step 2: Declare the following terms: X1, Y1, X2, Y2, DX, DY, X, and Y as integer variables.
Step 3: Enter thes values of X1,X2,Y1,Y2.
Step 4: Calculate the avlue of DX: DX = X2-X1
Step 5: Calculate the value of DY: DY = Y2-Y1
Step 6: If (absolute(DX) > absolute (DY))
Steps = absolute (DX)
else
Steps = absolute(DY);
Step 7: Xincrement = DX/Steps;
Yincrement = DY/Steps;
Step 8: Set pixel (x, y)
Step 9: for(int i=0; i<Steps; i++);
{
X = X + Xincrement;
Y = Y + Yincrement;
Set pixels(Round (X), Round (Y));
}

This is a brief mathematical explanation of the algorithm which we will be using. The algorithm is not intensive at all for linear cases and can easily be implemented. The proper implementation of this algorithm leads to quite clear lines/ polygons. The algorithm essentially interpolates the values between the starting and ending points provided and paints the pixels accordingly. It is an easy and simple algorithm and is a base for all the advances that have taken place further in the field of computer graphics generation. Hence we used DDA to generate some simple graphics and get a better idea as well as hands-on experience in computer graphics generation.

Fig 1: Sample Output



VI. Scope of the Project

1] It can create figures and graphical structures which are used for displaying purposes in many commercial industries.

2] Not just drawing 2D figures but doing some modifications using other graphics generating techniques we can display 3D figures too.

3] The objects or shape is drawn by connecting the previous points to the consecutive points, and geometry concepts along with the DDA algorithm are involved while drawing the required figure.

VII. FUTURE SCOPE

The scope of computer graphics as well as designing is increasing day by day because without both of them no business can run smoothly, efficiently, and effectively. Every business use digital illustration, colours, images, and photo editing software to create designs. As we all know that designing is very essential for all purposes like advertising, packaging, logos, hoardings, flex, publishing houses, production houses, brochures, pamphlets, and many more sectors. Everybody wants the latest and unique designs for their business, and to make those designs we need

computer graphics. So, it is very true to say that computer graphics and designs are the leading sectors in which we can make our careers bright and fruitful.

VIII. *CONCLUSION*

Computer graphics is a vast topic and the generation of computer graphics has evolved and developed a lot throughout the past few decades and is continuing to grow at an exponential rate. Increasing popularity, development in software as well as hardware, the evolution of new algorithms to generate specific structures or elements, and overall more focus on the topic has caused the development to be significant throughout the years. Its scope is very broad and it is a vast topic with numerous opportunities for research and development as well as efficient application.

IX. REFERENCES

[1] V. Cantoni, P. Dondi, L. Lombardi, and A. Setti, "Teaching Computer Graphics Through a Digital Humanities Project," in IEEE Computer Graphics and Applications, vol. 39, no. 2, pp. 89-94, 1 March-April 2019, DOI: 10.1109/MCG.2019.2895487.

[2] "IEEE Computer Graphics and Applications," in Computer, vol. 54, no. 6, pp. 58-58, June 2021, DOI: 10.1109/MC.2021.3078281.

[3] "IEEE Computer Graphics and Applications," in IEEE Intelligent Systems, vol. 36, no. 6, pp. 31-31, Nov.-Dec. 2021, DOI: 10.1109/MIS.2021.3132472.

[4] V. L. Paucar, O. S. de Sousa, I. O. Almeida, M. J. Rider, M. F. Bedrinana and J. H. Santos, "Software development with computer graphics, distributed database, and OOP for deregulated power systems analysis," 2004 Large Engineering Systems Conference on Power Engineering (IEEE Cat. No.04EX819), 2004, pp. 198-202, DOI: 10.1109/LESCPE.2004.1356300.

[5] Colin Li, Chao Yin, Jiajie Lu, and Lizhuang Ma, "Automatic 3D scene generation based on Maya," 2009 IEEE 10th International Conference on Computer-Aided Industrial Design & Conceptual Design, 2009, pp. 981-985, DOI: 10.1109/CAIDCD.2009.5375246.

[6] Ying Gui, Yuling Wang, and Niande Jiang, "Research and realization of visualization instruction on Computer Graphics, ," 2011 3rd International Conference on Computer Research and Development, 2011, pp. 344-347, DOI: 10.1109/ICCRD.2011.5764147.

[7] R. Pickles, "White Paper - Next Generation Graphics GPU Shader and Compute Libraries," 2020 AIAA/IEEE 39th Digital Avionics Systems Conference (DASC), 2020, pp. 1-6, DOI: 10.1109/DASC50938.2020.9256444.

[8] H. Wang, W. Chen, X. Liu, and B. Dong, "An improving algorithm for generating real sense terrain and parameter analysis based on a fractal," 2010 International Conference on Machine Learning and Cybernetics, 2010, pp. 686-691, DOI: 10.1109/ICMLC.2010.5580560.

[9] M. Oku, "Bubbloid Algorithm: A Simple Method for Generating Bubble-like Line Drawings," 2019 8th International Congress on Advanced Applied Informatics (IIAI-AAI), 2019, pp. 954-959, DOI: 10.1109/IIAI-AAI.2019.00191.

[10] "Generating Interactive Computer Graphics," PapersOwl.com, 28-Mar-2019. [Online]. Available: https://papersowl.com/examples/generating-interactive-computer-graphics/. [Accessed: 20-Mar-2022]

[11] "IEEE Transactions on Visualization and Computer Graphics," in IEEE Transactions on Visualization and Computer Graphics, vol. 26, no. 5, pp. i-i, May 2020, DOI: 10.1109/TVCG.2020.2978985.

[12] "IEEE Transactions on Visualization and Computer Graphics - 2014 IEEE Virtual Reality Conference [title page]," in IEEE

[13] Transactions on Visualization and Computer Graphics, vol. 20, no. 4, pp. iii, April 2014, DOI: 10.1109/TVCG.2014.44.

[14] Vayadande, Kuldeep, Ritesh Pokarne, Mahalaxmi Phaldesai, Tanushri Bhuruk, Tanmai Patil, and Prachi Kumar. "SIMULATION OF CONWAY'S GAME OF LIFE USING CELLULAR AUTOMATA." International Research Journal of Engineering and Technology (IRJET) 9, no. 01 (2022): 2395-0056.

[15] Vayadande, Kuldeep, Ram Mandhana, Kaustubh Paralkar, Dhananjay Pawal, Siddhant Deshpande, and Vishal Sonkusale. "Pattern Matching in File System." International Journal of Computer Applications 975: 8887.

[16] Vayadande, Kuldeep, Neha Bhavar, Sayee Chauhan, Sushrut Kulkarni, Abhijit Thorat, and Yash Annapure Spell Checker Model for String Comparison in Automata. No. 7375. EasyChair, 2022.

[17] VAYADANDE, KULDEEP. "Simulating Derivations of Context-Free Grammar." (2022).

[18] Varad Ingale, Kuldeep Vayadande, Vivek Verma, Abhishek Yeole, Sahil Zawar, Zoya Jamadar. Lexical analyzer using DFA, International Journal of Advance Research, Ideas and Innovations in Technology, www.IJARIIT.com.

[19] Kuldeep Vayadande, Harshwardhan More, Omkar More, Shubham Mulay, Atahrv Pathak, Vishwam Talanikar, "Pac Man: Game Development using PDA and OOP", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395-0056, p-ISSN: 2395-0072, Volume: 09 Issue: 01 | Jan 2022, www.irjet.net.

[20] Kuldeep B. Vayadande, Parth Sheth, Arvind Shelke, Vaishnavi Patil, Srushti Shevate, Chinmayee Sawakare, "Simulation and Testing of Deterministic Finite Automata Machine," International Journal of Computer Sciences and Engineering, Vol.10, Issue.1, pp.13-17, 2022.

[21] Rohit Gurav, Sakshi Suryawanshi, Parth Narkhede, Sankalp Patil, Sejal Hukare, Kuldeep Vayadande," Universal Turing machine simulator", International Journal of Advance Research, Ideas and Innovations in Technology, ISSN: 2454-132X, (Volume 8, Issue 1 - V8I1-1268, https://www.ijariit.com/.

[22] https://www.semanticscholar.org/paper/A-Computer-Graphics-System-for-Block-Diagram-Belady-Blasgen/552dfc9d542097b5b21ab770b0d64faa1d309497/figure/1.

[23] Kuldeep Vayadande, Krisha Patel, Nikita Punde, Shreyash Patil, Srushti Nikam, Sudhanshu Pathrabe, "Non-Deterministic Finite Automata to Deterministic Finite Automata Conversion by Subset Construction Method using Python," International Journal of Computer Sciences and Engineering, Vol.10, Issue.1, pp.1-5, 2022.

[24] Kuldeep Vayadande and Samruddhi Pate and Naman Agarwal and Dnyaneshwari Navale and Akhilesh Nawale and Piyush Parakh," Modulo Calculator Using Tkinter Library", EasyChair Preprint no. 7578, EasyChair, 2022.